Memo: Invergordon Road / Montessori Academy – Traffic Analysis

Date: 12/21/16
TO: Chief Peter Wingert, Paradise Valley Police Department
FROM: Eric Maceyko, P.E., PTOE
Bryan A. Martin, P.E.

INTRODUCTION

The Town of Paradise Valley is evaluating the travel speeds and potential for changes to the existing posted speed limit signing on Invergordon Road within the vicinity of the Montessori Academy. Montessori Academy is a private pre-school and public kindergarten to 8th Grade charter school with an enrollment of more than 200 students.

The school currently experiences a typical morning arrival and afternoon dismissal peak period of traffic generation. The current practice of the Montessori Academy is to place two (2) 15 mph speed limit signs in the center of Invergordon Road, one each in the northbound and southbound directions in advance of the school driveways during the peak arrival and dismissal hours.

EPS Group has been retained to conduct a Traffic Analysis to evaluate current traffic conditions and recommend the appropriate posted speed limit signing.

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STUDY AREA

Figure 1 provides a map of the study area. The existing Montessori Academy is located on the west side of Invergordon Road approximately 500 feet north of McDonald Drive. Within the study area, Invergordon Road is a straight, flat undivided north-south roadway consisting of one travel lane in each direction with a posted speed limit of 35 mph. There are also bike lanes in both directions. A continuous sidewalk is only present on the east side of Invergordon Road and no school crossing currently exists.

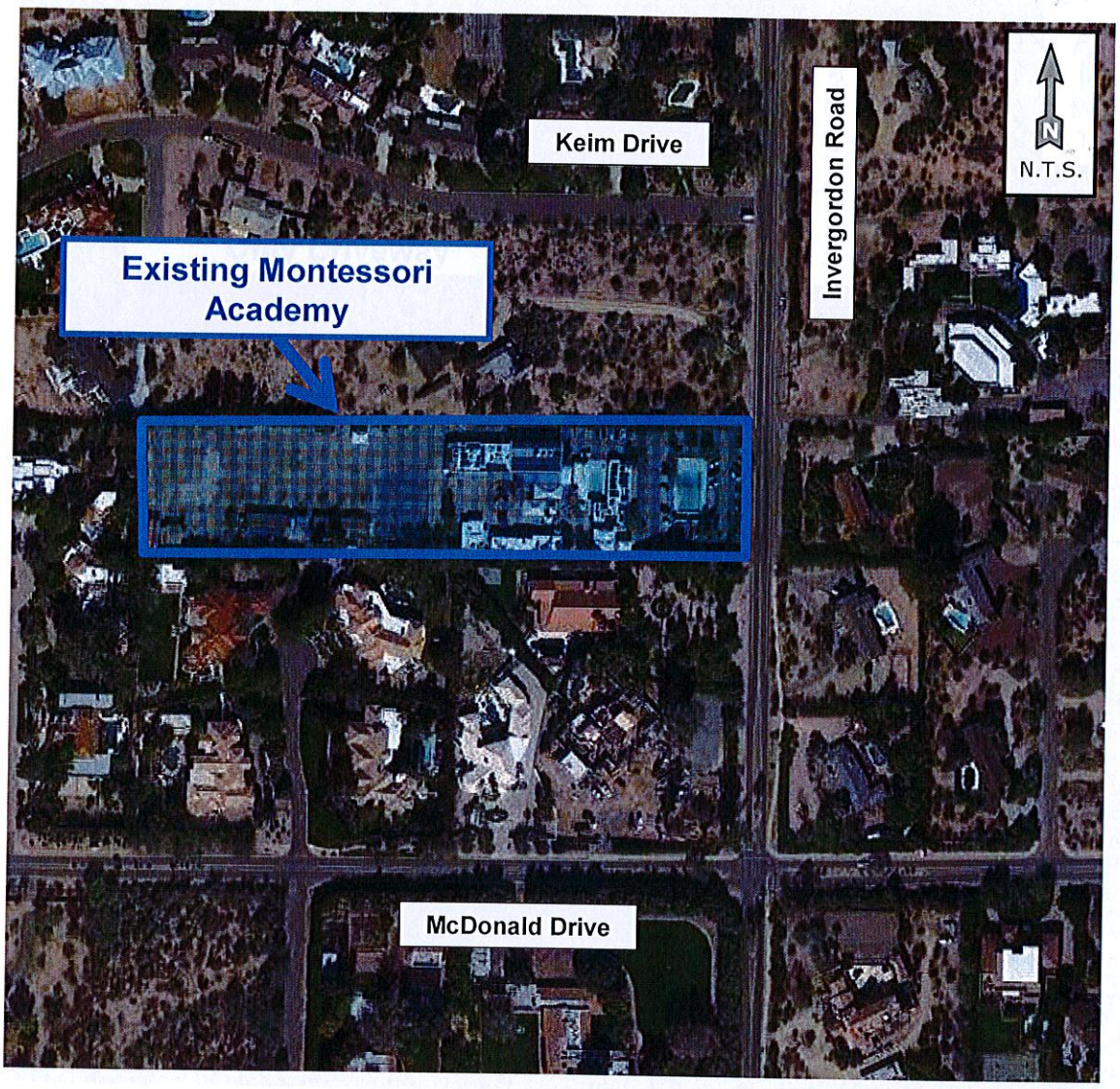


Figure 1: Study Area

The existing Montessori Academy provides access to Invergordon Road via one (1) full access ingress-only driveway to the north and one (1) full access egress-only driveway to the south. The driveways are separated by a distance of approximately 160 feet. No right or left-turn deceleration lanes are present for either access. There is an offset driveway on the east side of Invergordon Road just north of the Montessori Academy ingress-only driveway. This driveway serves the Calvary Church of the Valley property. **Figure 2** provides a close-up view of the current school access on Invergordon Road.

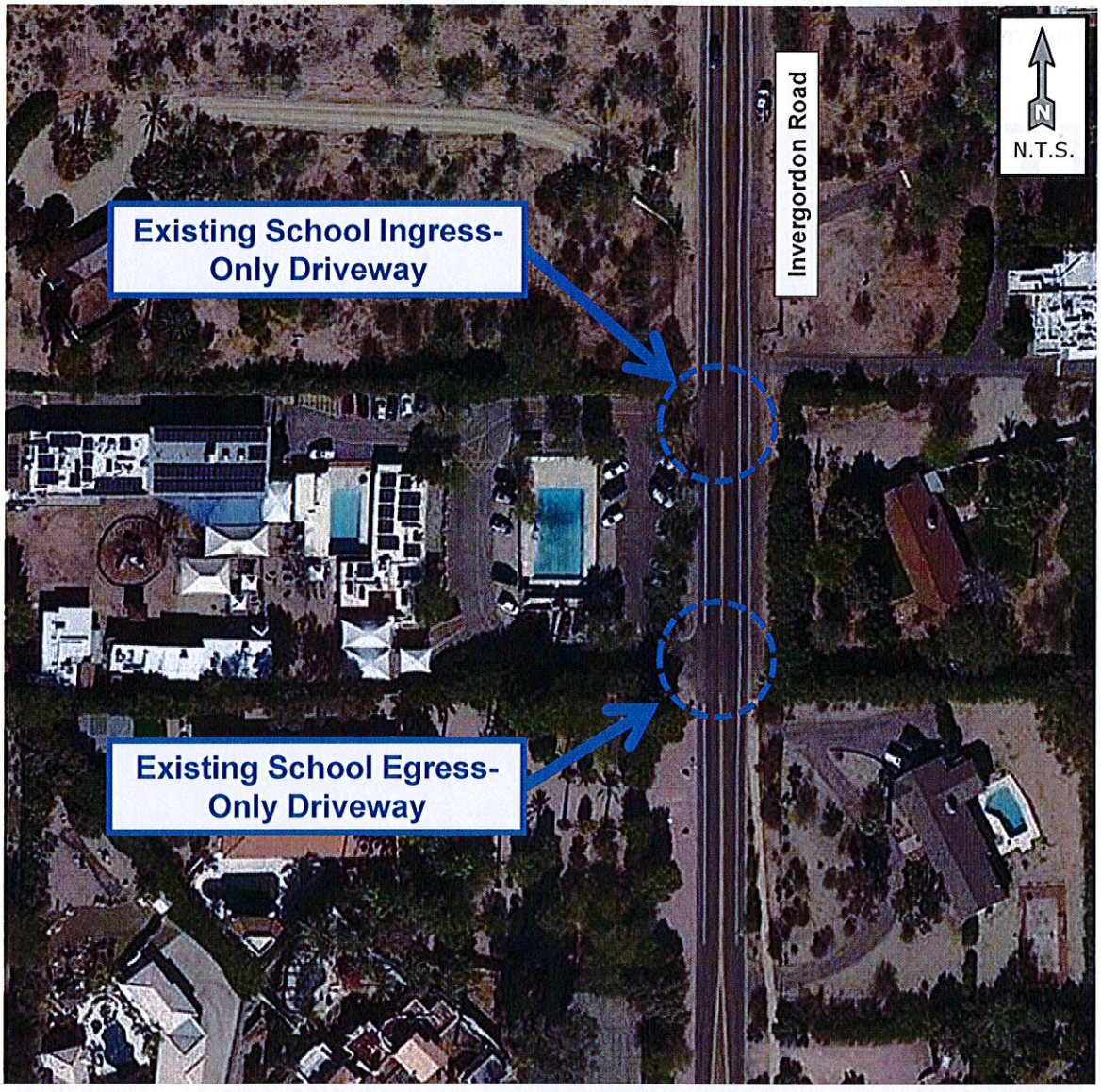


Figure 2: Current School Access

TRAFFIC DATA

Current traffic volume and travel speed data was collected for a 24-hour period on Tuesday, 15 November 2016. The peak hours of traffic on Invergordron Road generally occurred from 8:00 to 9:00 AM and 5:00 to 6:00 PM. The designated school drop-off time is from 8:00 to 8:30 AM, and pick-up times are from 2:50 to 3:15 PM and 3:30 to 3:45. Therefore, peak hour pedestrian counts were also conducted on Tuesday, 15 November 2016 from 7:45 to 8:45 AM, and from 2:45 to 3:45 PM. **Figure 3** depicts the traffic data measurement locations. **Attachment A** provides the traffic count data. **Attachment B** provides the pedestrian count data.

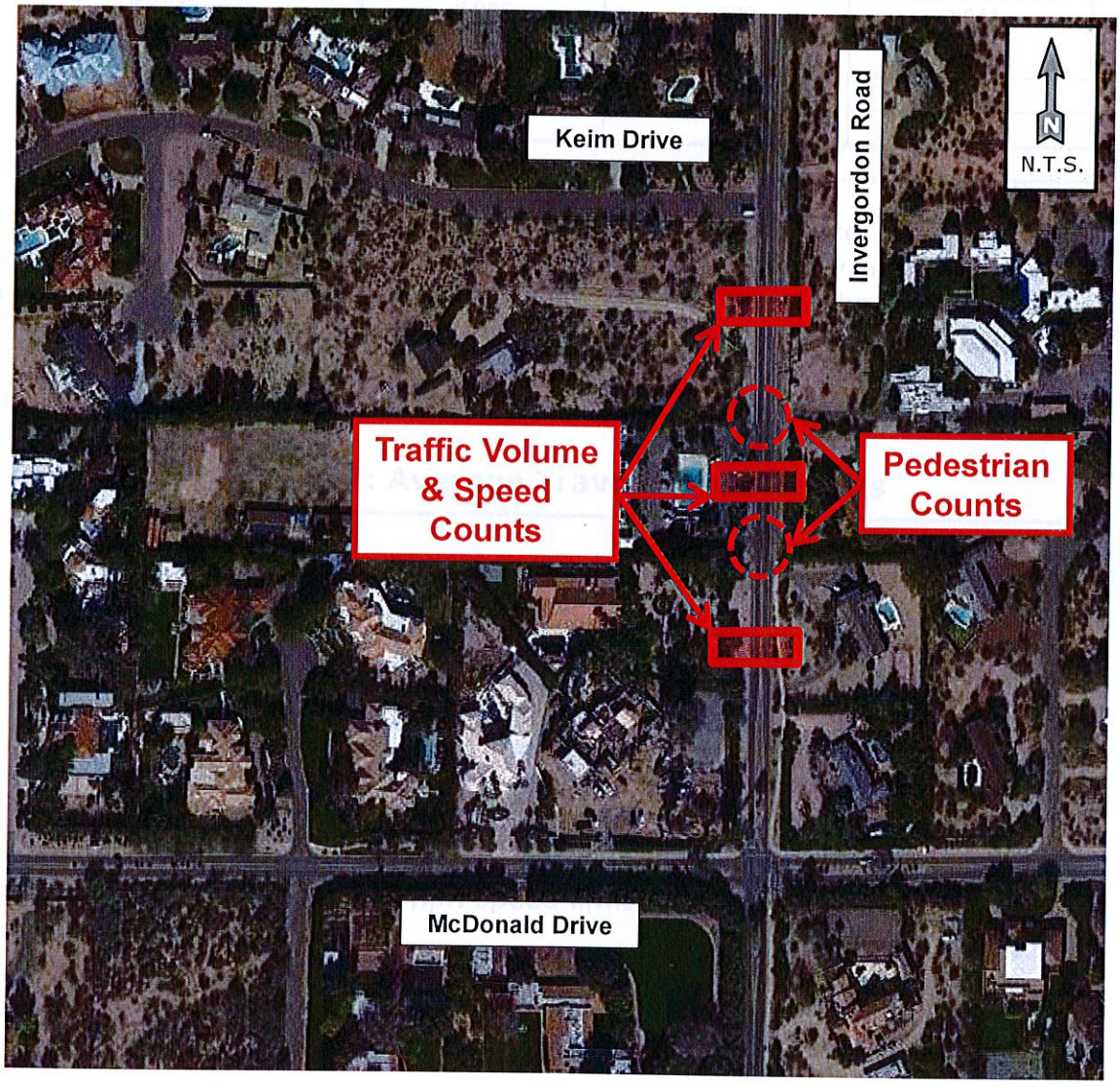


Figure 3: Traffic Data Measurement Locations

The resulting 24-hour, morning peak hour, and evening peak hour traffic volumes for Invergordon Road are summarized in **Table 1**. The morning peak hour of the school coincides with the morning peak hour of Invergordon Road traffic. The evening peak hour of the school occurs earlier than the evening peak hour of Invergordon Road traffic. Therefore, an additional school evening peak hour has been included in the table for use in the traffic analysis.

Table 1: Existing Traffic Volume Results

Time Period	Invergordon Road, South of School	Invergordon Road, Adjacent to School	Invergordon Road, North of School
Day (24 Hours)	6,955	6,720	7,013
AM Peak Hour	578	551	596
PM (School) Peak Hour	476	415	470
PM Peak Hour	695	678	716

The typical maximum capacity of a two-lane undivided roadway such as Invergordon Road is approximately 8,500 vehicles per day per lane. Therefore, the current traffic volumes are at less than 50% of the typical maximum capacity. This level of excess capacity can encourage high travel speeds.

The average travel speed data results are summarized in **Table 2**.

Table 2: Average Travel Speed Results

Time Period	Invergordon Road, South of School	Invergordon Road, Adjacent to School	Invergordon Road, North of School
Day (24 Hours)	31 mph	31 mph	35 mph
AM Peak Hour	21 mph	21 mph	25 mph
PM (School) Peak Hour	25 mph	25 mph	29 mph
PM Peak Hour	33 mph	33 mph	38 mph

Table 3 includes the total percentage of vehicles traveling at speeds greater than the currently posted 35 mph speed limit.

Table 3: Percentage Excess Speed Results

Time Period	Invergordon Road, South of School	Invergordon Road, Adjacent to School	Invergordon Road, North of School
Day (24 Hours)	24.9%	30.1%	44.2%

The data indicates that Invergordon Road, north of Montessori Academy, currently experiences the highest amount of traffic and highest average speeds. It can also be seen that there is a significant reduction in average speeds at each of the three (3) locations during the morning and school evening peak hours when compared to the overall day and evening peak hour of traffic on Invergordon Road. Additionally, a significant portion of drivers are exceeding the posted speed limit at all three (3) locations.

TRAFFIC ANALYSIS

Arizona State Traffic Law allows local authorities within their respective jurisdictions to determine or change the maximum speed limit on any part of a street or highway based on an engineering and traffic investigation (Arizona Revised Statutes, Section 28-703). **Attachment C** includes a copy of the pertinent excerpts of Arizona Revised Statutes. These studies are to be completed in compliance with the Manual on Uniform Traffic Control Devices (MUTCD, 2009 Edition, Section 2B-13) and the adopted state standards for traffic control devices.

The goal of a posted speed limit is to ensure safety and efficiency by reducing travel speed disparity. When vehicles are traveling at substantially different speeds, driver discomfort and collision potential increase. Driver uncertainty with potential vehicle movement on the same street or intersecting streets and driveways also increases. Mandatory speed limits have greater purposes than limiting the maximum travel speed. They are also intended to accommodate driver travel speed preference to improve efficiency and ensure safety.

The MUTCD lists six factors for consideration in determining speed limits – 85th Percentile Speed, Road Characteristics, Pace Speed, Roadside Development and Environment, Parking Practices and Pedestrian Activity, and Crash Experience. However, other criteria may require a more conservative speed limit established by engineering judgement that supersedes a speed limit based on these statistics alone. The following sections provide an analysis of each factor.

85th Percentile Speed:

The primary consideration provided in the MUTCD for determining the posted speed limit is the 85th percentile speed. This statistic represents the speed at which 85% of the vehicles are traveling at or below and 15% are traveling above. This is the prevailing speed of the vehicles traveling on the segment of roadway. **Table 4** provides the 85th percentile speed for the measured locations.

Table 4: 85th Percentile Speed Results

Time Period	Invergordon Road, South of School	Invergordon Road, Adjacent to School	Invergordon Road, North of School
Day (24 Hours)	38 mph	39 mph	48 mph
AM Peak Hour	35 mph	32 mph	33 mph
PM (School) Peak Hour	36 mph	36 mph	44 mph
PM Peak Hour	38 mph	39 mph	49 mph

As can be seen in **Table 4**, the 85th percentile speeds generally fall within the recommended 5 mph range from the posted speed limit, except on Invergordon Road north of the school. This segment experiences an 85th percentile speed of more than 10 mph from the posted speed limit on average. It can also be seen that there is a significant reduction in 85th percentile speeds at each of the three (3) locations during the morning and school evening peak hours when compared to the overall day and evening peak hour of traffic on Invergordon Road. The difference appears to be more pronounced during the morning peak hour which coincides with a higher ambient volume of traffic on Invergordon Road.

Road Characteristics:

Invergordon Road consists of pavement, curb, gutter, and sidewalk on the east side of the road. All appear in reasonably good condition with clearly visible pavement markings. The alignment of the road is straight with no significant vertical or horizontal alignment. Sight distance also appears adequate with no obvious obstructions or intersection alignment issues. There is landscaping present on both sides of Invergordon Road. The landscaping should be regularly monitored to ensure adequate sight distance is maintained.

Pace Speed:

The 10 mph pace speed is a secondary consideration suggested by the MUTCD. This speed is the 10 mph range of speeds that includes the largest number of vehicles. **Table 5** presents the 10 mph pace speeds at the study locations.

Table 5: Pace Speed Results

Time Period	Invergordon Road, South of School	Invergordon Road, Adjacent to School	Invergordon Road, North of School
Day (24 Hours)	31 - 40 mph	31 - 40 mph	26 - 35 mph

Typically a posted speed limit within the 10 mph pace speed, and close to the 85th percentile speed coincides with the lowest collision rate due to a subsequent reduction in the range of vehicle travel speeds. Therefore, the posted speed limit generally should be within the 10 mph pace speed, unless additional considerations necessitate a lower speed limit. The posted speed limit falls within the 10 mph pace speed at all three (3) locations.

Roadside Development and Environment:

Adjacent land uses consist primarily of low density single-family residences. Some residences have direct access to Invergordon Road and some have indirect access via local collector road intersections. Direct access is present more within the vicinity of the school and McDonald Drive, with indirect access present more to the north of the school.

Invergordon Road provides continuous bike lanes northbound and southbound, and a pedestrian sidewalk on the east side of the road only. There are no marked crosswalks for the school or at any other mid-block location.

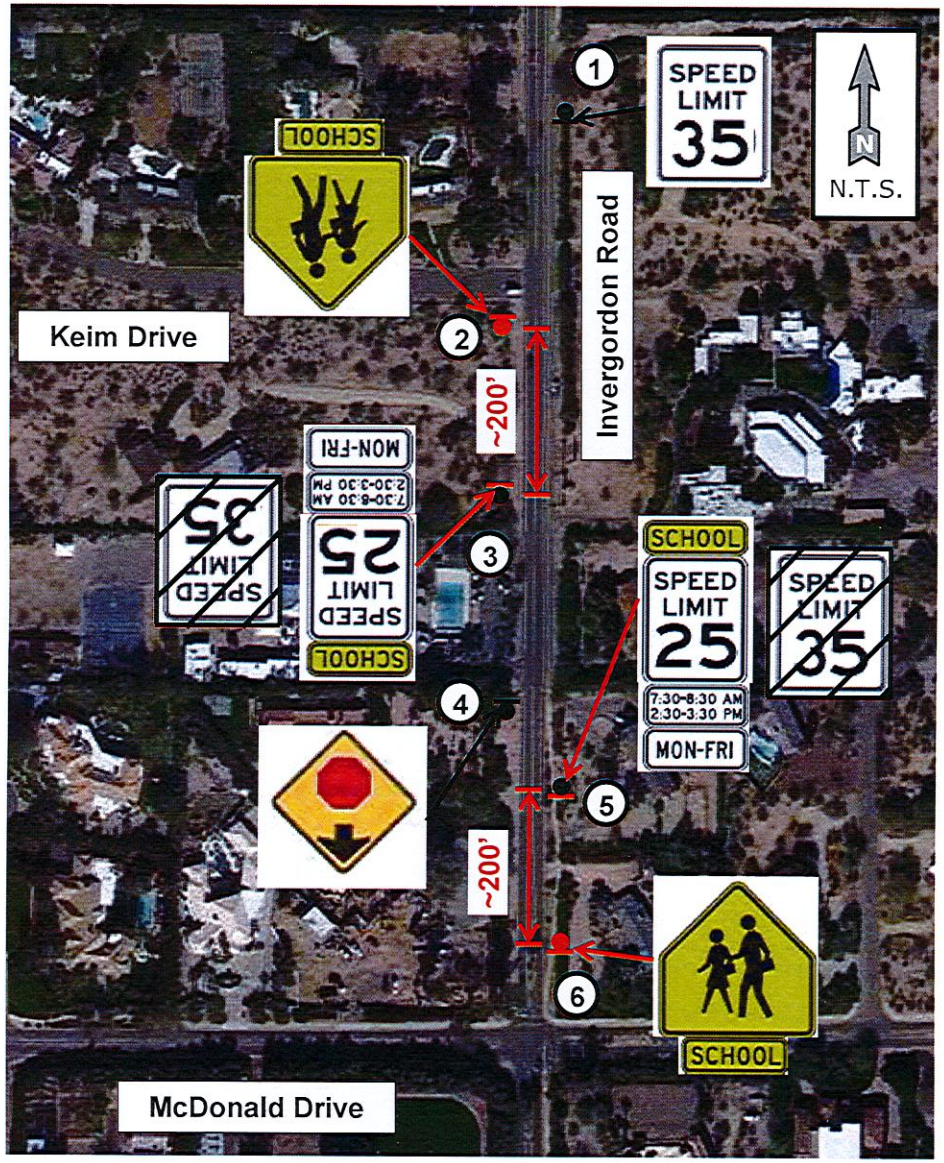
Parking Practices and Pedestrian Activity:

There is no dedicated parking on Invergordon Road within the study area. There are no posted parking restrictions, and no parking activity was observed. Onsite parking and circulation areas provided by the school appear adequate.

The pedestrian count data is summarized in **Table 6**.

Table 6: Pedestrian Count Results

Time Period	School Ingress Driveway, North	School Egress Driveway, South
AM Peak Hour	4	3
PM (School) Peak Hour	1	3



LEGEND

1. Existing R2-1 (35 MPH) Sign to Remain
2. New S1-1 (36"x36") and Optional S4-3P (24"x8") Plaque on New Post
3. Replace Existing R2-1 (35 MPH) Sign with New S4-3P (24"x8"), New R2-1 (24"x30") and Optional S4-1P (24"x10") and / or Optional S4-6P (24"x10") on Existing Post
4. Existing W3-1 Sign to Remain
5. Replace Existing R2-1 (35 MPH) Sign with New S4-3P (24"x8"), New R2-1 (24"x30") and Optional S4-1P (24"x10") and / or Optional S4-6P (24"x10") on Existing Post
6. New S1-1 (36"x36") and Optional S4-3P (24"x8") Plaque on New Post

Note: Actual installation locations of new posts to be field adjusted as necessary to provide adequate visibility and clearance. Reuse of existing posts and foundations to be field verified for viability and appropriate mounting height.

Figure 4: Recommended Signing Enhancements

Please contact me at (480) 503-2250, extension 125 if you have any questions or would like to discuss this memorandum.

ATTACHMENTS:

A. Existing Traffic Counts
B. Existing Pedestrian Counts
C. Pertinent Excerpts from Arizona Revised Statutes

Registered Professional Engineer (Civil)
CERTIFICATE NO. 42329
ERIC R. MACEYKO
Date Signed 12/4/2016
ARIZONA, U.S.A.

Expires:6/30/2017

ATTACHMENT A
EXISTING TRAFFIC COUNTS

EPS GROUP

Field Data Services of Arizona

21636 N. Dietz Dr.
Maricopa, AZ 85138
520.316.6745

Site Code: 16-1425-001
Station ID: Tues 11/15/16
Invergordon Rd. north of Montessori
Academy (s/o Keim Dr.) 33.5258,-111.9432
Latitude: 0' 0.000 Undefined

Northbound

Start Time	0 10	11 15	16 20	21 25	26 30	31 35	36 40	41 45	46 50	51 55	56 60	61 65	66 70	71 71	Total	Average (Mean)	85th Percent
11/15/16	0	0	0	0	0	0	1	4	3	0	0	1	0	0	9	46	48
01:00	0	0	0	0	0	0	3	1	0	0	0	0	0	0	4	38	38
02:00	0	0	0	1	0	0	0	1	0	0	0	0	0	0	2	31	41
03:00	0	0	1	0	0	0	1	0	0	0	0	0	0	0	2	26	36
04:00	0	0	0	0	0	1	1	3	0	0	0	1	0	0	6	44	43
05:00	0	0	0	0	0	1	1	7	17	1	0	0	0	0	27	46	49
06:00	0	0	0	0	0	4	21	22	28	7	3	2	0	0	87	45	50
07:00	0	1	19	48	42	21	24	28	29	6	2	1	0	0	221	33	46
08:00	0	**3**	**33**	**113**	**68**	**39**	18	22	10	8	2	0	1	0	**317**	29	39
09:00	0	0	2	0	4	21	45	61	44	20	**11**	2	0	0	210	43	51
10:00	0	0	0	2	2	23	33	**64**	**61**	**29**	6	2	**2**	0	224	44	51
11:00	0	0	0	0	12	17	**53**	60	46	23	8	**6**	0	0	225	43	51
12 PM	0	1	1	2	3	13	33	81	64	29	8	2	1	0	238	45	51
13:00	0	0	1	3	1	16	47	72	61	25	8	0	0	0	234	44	50
14:00	0	**6**	**23**	**58**	**32**	15	34	34	38	16	2	1	0	0	259	34	48
15:00	0	1	6	6	25	**47**	69	78	60	29	13	4	0	0	338	41	50
16:00	0	0	2	1	3	27	67	112	106	43	11	**5**	**2**	0	379	44	51
17:00	0	0	0	6	6	24	**92**	**128**	**108**	**49**	16	1	1	0	**431**	44	51
18:00	0	0	0	0	2	4	21	59	61	45	**17**	2	1	0	212	47	54
19:00	0	0	0	0	0	1	20	34	35	21	7	1	1	0	120	47	53
20:00	0	1	2	0	2	4	21	32	35	11	6	1	0	0	115	44	51
21:00	0	0	0	0	0	1	12	25	20	9	2	1	1	0	71	46	51
22:00	0	0	0	0	1	3	7	13	9	9	3	1	0	0	46	46	53
23:00	0	0	0	0	0	0	5	6	3	5	0	0	0	0	19	45	52
Total	0	13	90	240	203	282	629	947	838	385	125	34	10	0	3796		
Percent	0.0%	0.3%	2.4%	6.3%	5.3%	7.4%	16.6%	24.9%	22.1%	10.1%	3.3%	0.9%	0.3%	0.0%			
AM Peak		08:00	08:00	08:00	08:00	08:00	11:00	10:00	10:00	10:00	09:00	11:00	10:00		08:00		
Vol.		3	33	113	68	39	53	64	61	29	11	6	2		317		
PM Peak		14:00	14:00	14:00	14:00	15:00	17:00	17:00	17:00	17:00	18:00	16:00	16:00		17:00		
Vol.		6	23	58	32	47	92	128	108	49	17	5	2		431		
Total	0	13	90	240	203	282	629	947	838	385	125	34	10	0	3796		
Percent	0.0%	0.3%	2.4%	6.3%	5.3%	7.4%	16.6%	24.9%	22.1%	10.1%	3.3%	0.9%	0.3%	0.0%			

15th Percentile :	31 MPH
50th Percentile :	43 MPH
85th Percentile :	50 MPH
95th Percentile :	55 MPH

Statistics

10 MPH Pace Speed :	41-50 MPH
Number in Pace :	1785
Percent in Pace :	47.0%
Number of Vehicles > 35 MPH :	2968
Percent of Vehicles > 35 MPH :	78.2%
Mean Speed(Average) :	42 MPH

Field Data Services of Arizona

21636 N. Dietz Dr.
Maricopa, AZ 85138
520.316.6745

Site Code: 16-1425-001
Station ID: Tues 11/15/16
Invergordon Rd. north of Montessori Academy (s/o Keim Dr.) 33.5258,-111.9432
Latitude: 0' 0.000 Undefined

Southbound Start Time	0 10	11 15	16 20	21 25	26 30	31 35	36 40	41 45	46 50	51 55	56 60	61 65	66 70	71 71	Total	Average (Mean)	85th Percent
11/15/16	0	0	0	0	3	2	0	0	0	0	0	0	0	0	5	29	31
01:00	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	31	31
02:00	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	26	26
03:00	0	0	0	1	1	1	0	0	0	0	0	0	0	0	3	29	31
04:00	0	0	0	0	4	6	1	0	0	0	0	0	0	0	11	31	34
05:00	0	0	0	1	18	16	1	0	0	0	0	0	0	0	36	30	34
06:00	0	0	1	13	52	55	6	0	0	0	0	0	0	0	127	30	34
07:00	2	42	56	43	43	41	6	**1**	0	0	**1**	0	0	0	235	23	32
08:00	**6**	**52**	**85**	**54**	55	25	2	0	0	0	0	0	0	0	**279**	21	29
09:00	0	1	2	25	**118**	**94**	**13**	0	0	0	1	0	0	0	254	30	34
10:00	1	1	2	16	96	70	4	0	0	**1**	0	0	0	0	191	29	34
11:00	0	0	4	33	111	79	3	0	**1**	0	0	**1**	0	0	232	29	34
12 PM	0	0	4	17	93	89	**14**	0	**1**	0	0	0	0	0	218	30	34
13:00	0	0	3	15	88	86	13	**1**	0	**1**	0	0	0	0	207	30	35
14:00	**3**	**32**	**59**	22	48	41	5	0	0	0	0	**1**	0	0	211	23	32
15:00	1	0	17	**35**	77	103	10	1	0	0	0	0	0	0	244	29	34
16:00	0	0	5	13	104	112	9	0	0	0	**1**	0	0	0	244	30	34
17:00	0	0	3	30	**126**	**116**	8	0	0	1	0	1	0	0	**285**	30	34
18:00	0	0	0	10	81	84	6	0	0	0	0	0	0	0	181	30	34
19:00	0	0	0	6	36	40	3	1	0	0	0	0	0	0	86	30	34
20:00	0	0	0	3	39	25	7	0	0	0	0	0	0	0	74	30	35
21:00	0	0	0	2	28	19	4	0	0	0	0	0	0	0	53	30	34
22:00	0	0	0	3	5	11	2	0	0	0	0	0	0	0	21	31	35
23:00	0	0	0	1	5	11	1	0	0	0	0	0	0	0	18	31	34
Total	13	128	241	343	1232	1127	118	4	2	3	3	3	0	0	3217		
Percent	0.4%	4.0%	7.5%	10.7%	38.3%	35.0%	3.7%	0.1%	0.1%	0.1%	0.1%	0.1%	0.0%	0.0%			
AM Peak	08:00	08:00	08:00	08:00	09:00	09:00	09:00	07:00	11:00	10:00	07:00	11:00			08:00		
Vol.	6	52	85	54	118	94	13	1	1	1	1	1			279		
PM Peak	14:00	14:00	14:00	15:00	17:00	17:00	12:00	13:00	12:00	13:00	16:00	14:00			17:00		
Vol.	3	32	59	35	126	116	14	1	1	1	1	1			285		
Total	13	128	241	343	1232	1127	118	4	2	3	3	3	0	0	3217		
Percent	0.4%	4.0%	7.5%	10.7%	38.3%	35.0%	3.7%	0.1%	0.1%	0.1%	0.1%	0.1%	0.0%	0.0%			

15th Percentile :	22 MPH
50th Percentile :	29 MPH
85th Percentile :	34 MPH
95th Percentile :	35 MPH

Statistics

10 MPH Pace Speed :	26-35 MPH
Number in Pace :	2359
Percent in Pace :	73.3%
Number of Vehicles > 35 MPH :	133
Percent of Vehicles > 35 MPH :	4.1%
Mean Speed(Average) :	28 MPH

ATTACHMENT B
EXISTING PEDESTRIAN COUNTS

EPS GROUP

FIELD DATA SERVICES OF ARIZONA, INC.
520.316.6745

veracitytrafficgroup

Pedestrian & Bicycle Study

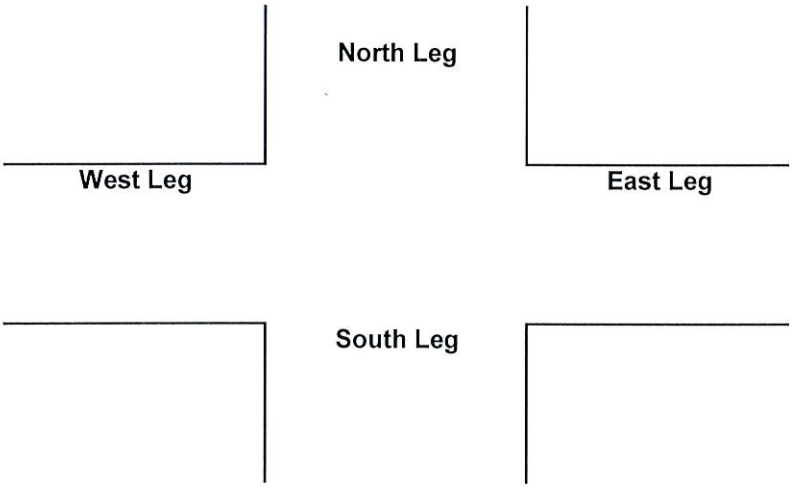
N-S STREET: Invergordon Rd.
E-W STREET: Montessori South Dwy

Date: 11/15/16
Day: TUESDAY

City: Paradise Valley
Project #: 16-1425-002

	PEDESTRIANS			
	N-LEG	S-LEG	E-LEG	W-LEG
7:45 AM	0	0	0	1
8:00 AM	0	0	0	2
8:15 AM	0	0	0	0
8:30 AM	0	0	0	0
TOTAL	**0**	**0**	**0**	**3**

	BICYCLES			
	N-LEG	S-LEG	E-LEG	W-LEG
7:45 AM	0	0	0	0
8:00 AM	0	0	0	0
8:15 AM	0	0	0	1
8:30 AM	0	0	0	0
TOTAL	**0**	**0**	**0**	**1**

	PEDESTRIANS			
	N-LEG	S-LEG	E-LEG	W-LEG
2:45 PM	0	0	0	1
3:00 PM	2	0	0	0
3:15 PM	0	0	0	0
3:30 PM	0	0	0	0
TOTAL	**2**	**0**	**0**	**1**

	BICYCLES			
	N-LEG	S-LEG	E-LEG	W-LEG
2:45 PM	0	0	0	0
3:00 PM	0	0	0	0
3:15 PM	0	0	0	0
3:30 PM	0	0	0	0
TOTAL	**0**	**0**	**0**	**0**